**[0005]** Ischemic heart disease and other clinical problems (fibrosis, etc.) can cause conduction delays and/or blockage in this high-speed network. For example, a left bundle block leads to late electrical activation of the left ventricular free wall. These conduction problems change the QRS complex in the ECG to a wide QRS complex greater than 120 ms. The corresponding electrical conduction delays cause mechanical dysfunction, decreased cardiac output, as well as valvular regurgitation. Clinical studies have shown early septal circumferential shortening, followed by late stretch as the left ventricular free wall ~~shortenings~~ <u>shortening</u> begins (Kawaguchi M, Murabayashi T, Fetics BJ, Nelson GS, Samejima H, Nevo E, Kass DA. Quantitation of basal dyssynchrony and acute resynchronization from left or biventricular pacing by novel-contrast variability imaging. Journal of the American College of Cardiology 2002; 39:2052-8.). This electrical-mechanical dyssynchrony decreases cardiac output and may cause or exacerbate mitral regurgitation.

**[0006]** The electrical synchrony can be partially restored by biventricular pacing. A pacemaker is implanted in the patient along with a right atrial, right ventricular, and left ventricular lead. The right atrial lead is used to sense the electrical activity in the right atrium and/or to stimulate the right atrium. The pacemaker senses this electrical activity and after a programmable delay (i.e., the delay can be different for each ventricle) electrically stimulates the right and left ventricles, thereby re-establishing electrical synchrony. The leads can be either bipolar or unipolar, and ~~general~~ <u>generally</u> consist of a coiled conductor, which is electrically isolated from the surrounding tissue. Numerous materials, such as platinum or tantalum coated MP35N alloy wire, can be used for the conductor. At the distal end, the conductor makes electrical contact with the tissue via an electrode, commonly a ring electrode. The electrode can elude an anti-inflammatory cortico-steroid, such as sodium dexamethasone, to reduce irritation of tissue adjacent to the electrode. Insulation materials such as polyurethane, silicone, and ethylene tetrafluor ethylenefluoropolymer are used. The proximal end is directly connected to the pacemaker through an IS-1 standard connector with a sealing-ring (de Voogt WG, Pacemaker leads: Performance and progress. American Journal of Cardiology 1999; 83:187D-191D).

**[0042]** Adjusting the strength or stiffness of the pacing lead can also assist this restraining force. To accomplish this purpose, the ideal lead would ~~incorporates~~ <u>incorporate</u> two extreme functions, namely, being relatively stiff to provide column strength along its length for

pushing the lead into the myocardial tissue, while offering a relatively flexible or floppy distal segment to avoid trauma to the epicardial surface and provide the desired steering characteristics. By selecting the appropriate balance of structural features and flexibility, the pacing lead can be advanced into the myocardium with relatively modest prospect of inadvertently exiting through the epicardium or endocardium. The pacing leads will thus preferably have variable flexibility along the length of the lead. U.S. Pat. No. 6,146,339 issued to Biagtan, for example, describes a guide wire with operator controllable tip stiffness. Many different approaches are available to vary the stiffness of the pacing leads. For example, U. S. Pat. No. 5,957,903 issued to Mirzaee describes a guidewire whose stiffness is adjusted by advancing or retracting a movable core within the guidewire.